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CLINGFISHES (Gobiesocidae) FROM BELIZE AND HONDURAS, CENTRAL AMERICA, WITH A REDESCRIPTION OF *Gobiesox barbatulus* STARKS[1]

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ABSTRACT: Six marine species and a single freshwater species of clingfish are reported from collections made by the authors in Belize and Honduras, Central America, during the period 1970 through 1980. *Acyrtops amplicirrus* Briggs, *Acyrtus rubiginosus* (Poey), and *Gobiesox barbatulus* Starks are reported for the first time from the western Caribbean and *Gobiesox nudus* (Linnaeus) is recorded for the first time from Honduras. *Acyrtops amplicirrus* is tentatively recognized as distinct from *A. beryllina* (Hildebrand and Ginsburg). *Gobiesox barbatulus* Starks is distinguished from *G. strumosus* on the basis of development of barbels on the pre- and suborbital areas, fringing of the dermal flaps on the anterior nostrils, and more numerous and narrow lines radiating from the eye in the case of *G. barbatulus*. Principal components analysis of 13 morphometric characters resulted in clear separation of the two forms along the first component axis. Both species are mainland forms occurring in turbid and often brackish water. *Gobiesox barbatulus* is a southern form occurring from Brazil to Belize, *G. strumosus* is a northern form occurring from Campeche, Mexico to Virginia. The apparent distributional boundary (centered on east coast of the Yucatan Peninsula, Mexico) between the two agrees with the boundary between the northern and southern continental shorefish faunas recognized by Robins (1971) and Gilbert (1973).

This paper is an annotated listing of clingfishes known from Belize and the Caribbean coast of Honduras, Central America. Results are based on ten years (1970-1980) of collecting in Belize and 31 collections in northern Honduras (Miskito Coast Expedition, 1975, see Greenfield and Johnson, 1981). Of 13 shallow-water[2] clingfish species (five genera) known from the western Atlantic, six species (four genera) are represented in our collections. A seventh species from freshwater in Honduras also is represented. Available information on habitat association, depth, and geographic distribution is presented for each of these seven species. We have also included revised descriptions for *Gobiesox barbatulus* and *G. strumosus* Cope, forms we believe to be separate. Evidence for this conclusion is presented and discussed. Localities and collecting methods used in our continuing study of the Belize

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[2]Not including *Derilissus* or *Gymnoscaphus*.

shorefish fauna are detailed in Greenfield and Johnson (1981), except for localities visited since completion of that work. In all we have obtained nearly 400 marine collections from Belize in ten years of work, but clingfishes were represented in only a small fraction of that total.

METHODS

Methods of making counts and measurements follow Briggs (1955) and descriptions follow the uniform format adopted by Briggs (1955, 1969a). Unless otherwise stated, all measurements are expressed as thousandths of standard length (SL). Counts were taken from radiographs or alizarin-stained and partly-dissected specimens. Measurements were made to 0.1 mm using dial calipers or needle-point dividers and to 0.01 mm using an ocular micrometer on a Wild M5 microscope.

In all cases material taken by us is listed first, by Field Museum of Natural History (FMNH) catalogue number, with the total number of specimens indicated in parentheses. In the case of species taken in Honduras, part of the material is deposited at the University of Michigan Museum of Zoology and this is indicated by listing the appropriate UMMZ catalogue number. Abbreviations used in listing comparative material examined are as follows: CAS and CAS-SU, California Academy of Sciences (San Francisco); GCRL, Gulf Coast Research Laboratory (Ocean Springs, MS); MPM, Milwaukee Public Museum (WI); UF, Florida State Museum, University of Florida (Gainesville); UMMZ, University of Michigan Museum of Zoology (Ann Arbor); ZMA, Zoologisch Museum, Amsterdam (The Netherlands). Additional collections were taken by J.W. Cooper (JWC) and by other S.I. personnel of the I.M.S.W.E. program.

Principal components analyses of the data set for *Gobiesox* specimens were done using the program "Factor" and associated programs of the NT-SYS package of programs (Rohlf, Kishpaugh and Kirk, 1972). Thirteen morphometric characters (Table 2), expressed as proportions of the standard length, formed the data base.

The data were standardized, a correlation matrix calculated, and the analysis was performed on that matrix. This usage is in parallel with the methods of Neff and Smith (1979) and Freeman (1981). All principal components analyses were done using the AMDAHL 470 V/7 Computer at the University of Chicago Computation Center.

Other statistical techniques were performed using a Hewlett-Packard 9100B calculator and plotter (with programs written by Dr. J.H. Zar at Northern Illinois University), and a Hewlett-Packard 9825A calculator and 9827A plotter at Field Museum of Natural History (using the basic statistics package supplied by the manufacturer), and standard reference works (Sokal and Rohlf, 1969; Tate and Clelland, 1957).

Abbreviations for localities in Honduras are as follows: BRL, Brus Lagoon; CC, Hog Islands (Cayos Cochinos); IR, Isla Roatan. Abbreviations for localities in Belize: Corozal District: AC, Ambergris Cay; Belize District: CCK, Cay Caulker; SGC, Sergeant's Cay; Stann Creek District: CBC, Carrie Bow Cay; CUR, Curlew Cay (just south of CBC); GR, Glovers Reef; SWC, South Water Cay. Toledo District: MSC, Middle Snake Cay; SSC, South Snake Cay; UNC, Mangrove-covered Cay (unnamed) ca. 2.5 mi. WSW of Wilson's Cay.

SPECIES ACCOUNTS

Acyrtops amplicirrus Briggs 1955

Acyrtops amplicirrus was described

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from 14 specimens taken at St. Thomas, Virgin Islands (Briggs 1955: 74-75). This species was said to differ from *A. beryllina* (Hildebrand and Ginsburg, 1927) in eye diameter (1.6 to 1.9 in interorbital width vs. 1.3 to 1.5 in *A. beryllina*) and in length of the dermal flap on the anterior (tubular) nostril (length equal to or greater than distance between anterior and posterior nostrils vs. less than distance between anterior and posterior nostrils in *A. beryllina).* Gould (1965) in a detailed work on the emerald clingfish, *A. beryllina,* from Florida, synonymized *A. amplicirrus* with *A. beryllina.* He found (p. 185) the dermal flap in *A. beryllina* varied from smaller to larger than the distance between the anterior and posterior nostrils. He also stated (p. 185) the bony interorbital/cornea diameter ratios for his material " . . . are in a continuous series of values from 0.95 to 1.65 or higher" (the highest value for a Florida specimen was 1.48; values for two incompletely described Virgin Island specimens were 1.59 and 1.65). Our specimens from Belize and examination of comparative material from Quintana Roo, Mexico, confirm Gould's finding for dermal-flap length (Fig. 1), with values varying from less than to greater than (the typical case) the distance between the anterior and posterior nostril. There is virtually complete overlap in values between Gould's Florida specimens and our material from the western Caribbean. Despite substantial overlap (Table 1), cornea diameter is on the average smaller and interorbital width on the average is greater in western Caribbean specimens than in Florida material we have examined. Plotting of cornea diameter against interorbital width (Fig. 2) results in near (not complete) separation of specimens from these two areas. Values for two paratypes (CAS-SU 1801, 16.2 and 18.3 mm S.L.) from St. Thomas as well as two specimens (UF 11964, 11.5 and 11.6 mm S.L.) from Antigua agree with the western Caribbean material (Fig. 2).

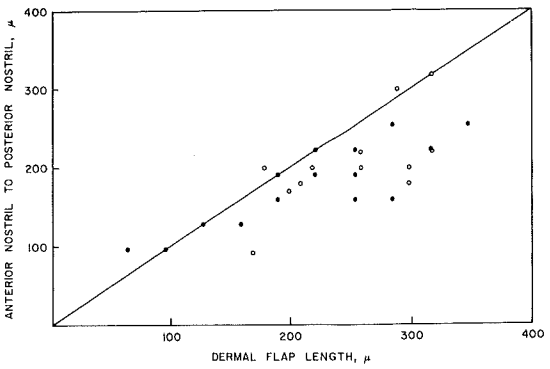

Figure 1. Comparison of dermal-flap length with distance from anterior to posterior nostril. Based on 12 specimens (13.4 to 18.5) from Belize and Quintana Roo, Mexico) (open symbols) and on 22 specimens (5.5 to 19.5) from Florida (closed symbols, data from Gould 1965). Included is line for one to one, y:x, relationship.

A composite index (Fig. 3) based on head length, cornea diameter and interorbital width gives 100% separation of the Florida material from all other material. This index was constructed by comput-

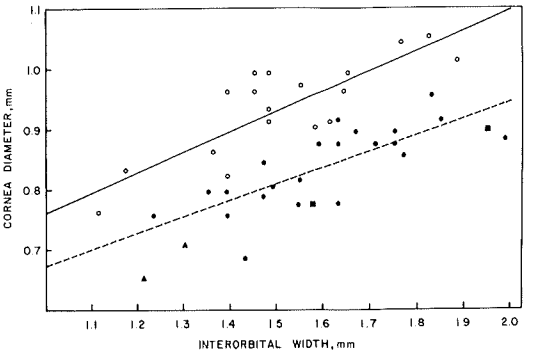

Figure 2. Linear regression of cornea diameter (ordinate, CD, in mm) on interorbital width (abscissa, IO, in mm) for two species of *Acyrtops: A. amplicirrus* (closed circles) and *A. beryllina* (open circles). Included for reference purposes (but not included in the regession analyses) two paratypes of *A. amplicirrus* from St. Thomas (closed squares) and two specimens fo *A. amplicirrus* from Antigua (closed triangles). Regression equations, line for *A. amplicirrus* ($y = 0.272x + 0.401$); line for *A. beryllina* ($y = 0.334 x + 0.427$).

Table 1. Comparison of proportional measurement data for two species of *Acyrtops*. Given as the mean, 95% limits for the mean and range (in parentheses). Values for the two paratypes of *A. amplicirrus* given separately.

	A. beryllina Florida	*A. amplicirrus* Western Caribbean	*A. amplicirrus* St. Thomas (paratypes)	
N (range in S.L.)	10 (11.7-20.1)	10 (12.0-18.6)	16.2	18.3
Head length[1]	338 ± 2.9 (329 - 349)	361 ± 5.5 (347 - 398)	346	344
Head width	308 ± 10.5 (285 - 328)	297 ± 10.9 (272 - 320)	310	299
Snout length	103 ± 4.9 (92 - 114)	101 ± 6.6 (89 - 116)	106	104
Cornea diameter[1]	58 ± 106 (52 - 65)	53 ± 1.5 (48 - 61)	48	49
Interorbital width[1]	92 ± 2.1 (84 - 99)	102 ± 2.8 (89 - 110)	97	106
Anus to posterior margin of disc	216 ± 12.8 (190 - 245)	231 ± 14.8 (207 - 261)	248	247
Anus to anal-fin origin	118 ± 6.2 (102 - 130)	111 ± 7.6 (95 - 129)	106	96
Pre-dorsal distance	762 ± 14.2 (737 - 786)	752 ± 6.0 (741 - 771)	747	738
Dorsal-caudal distance	182 ± 5.9 (172 - 192)	173 ± 12.2 (153 - 209)	188	195
Chin to anterior margin of disc	179 ± 6.5 (166 - 191)	176 ± 6.6 (161 - 188)	163	187
Disc length	193 ± 4.4 (184 - 204)	192 ± 10.1 (173 - 215)	198	177
Disc width	171 ± 4.3 (163 - 181)	171 ± 6.5 (157 - 187)	173	
Caudal peduncle length	165 ± 5.5 (150 - 176)	155 ± 8.8 (136 - 175)	153	163
Caudal peduncle depth	104 ± 6.7 (94 - 119)	104 ± 5.1 (93 - 116)	98	97
Composite index [1,2] range	(88 - 113)	(115 - 140	(124)	(132)

[1] *A. beryllina* — based on 20 (11.7 - 20.1) specimens.
A. amplicirrus — based on 23 (12.0 - 18.6) specimens.
[2] see text for explanation.

ing a standard score for each character for each specimen based on an adjustment to a mean value of 100 for each character for all specimens of *A. beryllina* from Florida. The composite index for each specimen was then calculated as

$$CIj = Z_{1,j} + Z_{2,j} - Z_{3,j}$$

where Z_1,j is the standard score for each specimen (j) for head length, Z_2,j for interorbital width, and Z_3,j for cornea diameter.

Counts for the western Caribbean specimens do not differ from counts reported by Gould for Florida specimens. Ranges of values for western Caribbean material: dorsal-fin rays 5 to 7 (1 or 2 spine-like); anal-fin rays, 5 to 6 (1 spine-like); pectoral-fin rays, 21 to 23; caudal-fin rays 4–5+8+4+4–5 (Gould included the posteromost pair of procurent caudal-fin rays in his values for principal caudal-fin rays). Other morphometric characters (Table 1) do not appear to differ between Florida and western Caribbean material.

We recognize that the differences

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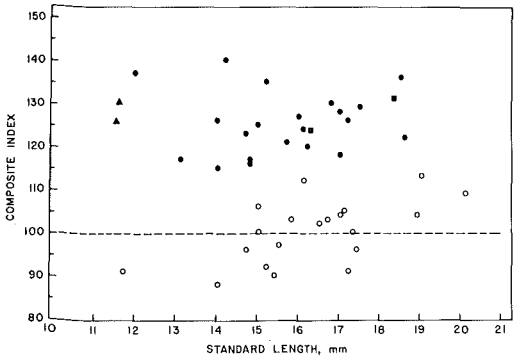

Figure 3. Composite index (ordinate) plotted against standard length (abscissa) for 47 specimens of *Acyrtops*. See text for derivation of composite index.
A. beryllina (open circles)
A. amplicirrus, Belize (closed circles)
A. amplicirrus, paratypes, St. Thomas (closed squares)
A. amplicirrus, Antigua (closed triangles)

reported here between the Florida and western Caribbean material are few, quantitatively slight, and possibly ascribable to (unknown) environmental differences between the two areas; however, we note the ability to separate on a 100% basis Florida and western Caribbean material (Fig. 3) and note that values for the two paratypes and two specimens from Antigua examined agree with those of the western Caribbean specimens. We believe these findings indicate the need for synoptic study of the "emerald clingfish" throughout the range of this (these) species. Such a study is beyond the scope of the present paper, but we choose to call attention to the problem by using the available name *Acyrtops amplicirrus* for the western Caribbean material.

Acyrtops amplicirrus has hitherto been recorded only from the Virgin Islands. *Acyrtops beryllina* has been recorded from the Bahamas, Florida and Greater and Lesser Antilles (Briggs 1955, Gould 1965, Böhlke and Chaplin 1968, Böhlke and Robins 1970). Birdsong and Emery (1968) reported *A. beryllina* from Belize but apparently did not compare their material with specimens from elsewhere. Böhlke and Chaplin (1968, p. 703) and Randall (1968, p. 288) note the restriction of *A. beryllina* to turtlegrass beds. All material reported herein as *A. amplicirrus* was taken in *Thalassia* beds in less than 5 feet of water.

Material examined. 5 specimens from 1 collection. BELIZE: CCK, FMNH 84320 (5). Comparative material examined. 18 specimens from 3 collections. BELIZE: CBC, JWC-12 (1), JWC-13 (10), MEXICO, QUINTANA ROO: Akumal Bay, MPM 22492 (7).

Acyrtus artius Briggs 1955[3]

This species is known from the Bahamas, Virgin Islands, Curacao, Belize and the Yucatan, Mexico (Briggs 1955, Birdsong and Emery 1968, Bohlke and Chaplin 1968, Böhlke and Robins 1970). It has also been taken at Grand Cayman and Isla de Providencia (Burgess and Gilbert, pers. comm.). Briggs (1955, p. 126) distinguished *A. artius* from *A. rubiginosus* (Poey) on the basis of presence (*artius*) or absence (*rubiginosus*) of papillae in disc region C, number of rows of papillae in disc rows A and B (greater in each case in *artius*), and two morphometric characters (Fig. 4), head length and disc length, each as an inverse proportion of the SL (proportionately lesser in each case in *artius*). For material from Belize and Honduras values for the ratios (SL/head length) and (SL/disc length) differ without overlap between *A. artius* and *A. rubiginosus*. SL/head length: 2.03 to 2.47 (*artius*, n=52), 2.50 to 2.66 (*rubiginosus*, n=13). SL/disc length: 2.41 to 3.24 (*artius*, n=32), 3.39 to 3.52 (*rubiginosus*, n=13). Our results agree with differences noted by Briggs, although in the case of disc length differ somewhat in actual numerical values.

[3]our use of this generic name follows Briggs (1955, 1969b).

There is an apparent trend for specimens of *A. artius* from deeper water to have proportionately larger heads (Fig. 5) than specimens from shallower water. In a linear regression of (SL/head length) on depth of capture (mean of the upper and lower depth limits for each station) the correlation coefficient, r = -0.60 is highly significant ($p < .001$). Using the same data in computation of the nonparametric Kendall's rank-correlation coefficient, $tau_{52} = -0.41$, $p < .01$ (corrected for ties), the correlation of proportionate head length with mean capture depth proved similarly significant. The reason(s) for this relationship is (are) unknown, but presumably the relationship reflects differential growth rates at different depths. Whether this might be related to differences in food availability, environmental variation, or other factors cannot be established with available data.

Böhlke and Chaplin (1968, p. 705) described *A. artius* as a "common form" in the Bahamas frequently taken " . . . on large coral formations, or from patch reefs surrounded by white sand . . . " in depths from near the shoreline to 50 feet. In Belize we have taken *A. artius* in less than 3 feet and in stations as deep as 80 to 90 feet, always in areas of rich coral formations. Of 24 collections (61 specimens) of *A. artius* in our Belize material, 4 collections (9 specimens) came from

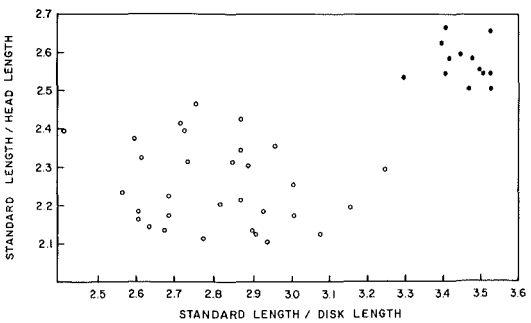

Figure 4. Comparison of head length vs. disc length (each as an inverse proportion of S.L.) for two species of *Acyrtus* from Belize and Honduras:
A. artius — open symbols
A. rubiginosus — closed symbols

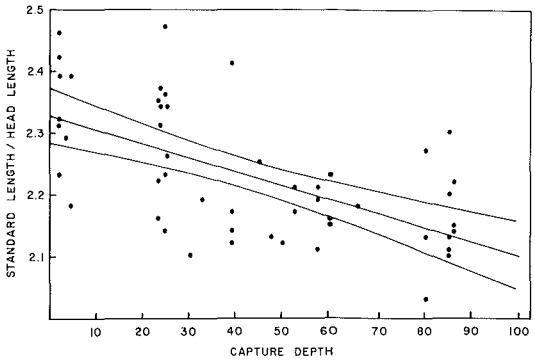

Figure 5. Linear regression of head length (as an inverse proportion of S.L.) against depth of capture (station midpoint, see text) for specimens of *Acyrtus artius* from Belize. Regression equation:
Y = 2.32762 - .00224 X.
Curved lines enclose 95% confidence limits for regression line.

patch reefs or similar coral formations in relatively sheltered shallow-water sites; 2 collections (4 specimens) from the steep windward dropoff at Glovers Reef; 15 collections (42 specimens) from spur and groove formations generally between 20 to 60 feet on the windward reef front at Ambergris Cay, Carrie Bow Cay, Curlew Cay and 3 collections (6 specimens) came from deep spur and groove formations, 60 to 100 feet, off Ambergris Cay. In Belize *A. artius* was taken at four Barrier Reef sites (Ambergris Cay, Carrie Bow Cay, Curlew Cay, Sergeants Cay) and at Glovers Reef.

Material examined: 61 specimens from 24 collections.

BELIZE: AC, FMNH 83938 (2), FMNH 83939 (3), FMNH 83940 (3), FMNH 83941 (1), FMNH 83942 (4); CBC, FMNH 84334 (6), FMNH 84335 (1), FMNH 84336 (1), FMNH 83935 (2); CUR, FMNH 83936 (5); GR, FMNH 83937 (2), FMNH 84321 (3), FMNH 84322 (1), FMNH 84323 (3), FMNH 84324 (4), FMNH 84325 (3), FMNH 84326 (1),FMNH 84328 (1), FMNH 84329 (3), FMNH 84330 (1), FMNH 84331 (7), FMNH 84332 (2), FMNH 84333 (1); SGC, FMNH 84327 (1).

Comparative material examined. 1 specimen from 1 collection.

BELIZE: CBC, JWC-10 (1).

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Acyrtus rubiginosus (Poey, 1868)

This species is known from the Bahamas and Greater and Lesser Antilles (Briggs 1955, Böhlke and Chaplin 1968, Böhlke and Robins 1970). It has also been taken at Grand Cayman and Isla de Providencia (Burgess and Gilbert, pers. comm.) This is apparently the first record from the western Caribbean. Böhlke and Chaplin (1968, p. 707) stated this species was most commonly taken in the Bahamas in areas of boulders and limestone, especially in small tidal pools on exposed windward coasts. In Honduras we have taken *A. rubiginosus* on 5 occasions, all from areas of rocky substrates (ledges and cobble), lacking extensive coral formations, and all in shallow water (less than 10 feet, 4 of 5 collections from less than 6 feet). In Belize we have taken *A rubiginosus* on only one occasion, a shallow (0 — 4 feet) station on the Barrier Reef crest at Ambergris Cay in an area of considerable rock, rubble, widely separated but well developed small coral patch reefs, and with extensive development of *Millepora* at the reef crest.

Material examined. 90 specimens from 6 collections.

HONDURAS: CC — FMNH 84337 (27), FMNH 84338 (3), FMNH 84339 (5), FMNH 84340 (14), FMNH 93748 (10), UMMZ 209481(27). BELIZE: AC, FMNH 83943 (4).

Comparative material examined. 10 specimens from 3 collections.

MEXICO, QUINTANA ROO: MPM 22441 (3), MPM 24928 (2). PUERTO RICO: FMNH 62069 (5).

Status of *Gobiesox barbatulus* Starks

Among recent collections of clingfishes from Belize and Honduras were a series of *Gobiesox* specimens taken in mainland sites around the prop roots of the red mangrove. These specimens (herein identified as *Gobiesox barbatulus* Starks 1913) most closely resemble *G. strumosus*, a species reported from the West Indies, Gulf and Atlantic coasts of the United States, Bermuda, and Brazil, but not yet recorded from the western Caribbean. The specimens from Belize and Honduras differ from Brigg's (1955, p. 116) diagnosis of *G. strumosus* in having the anus closer to the rear margin of the disc than to the anal-fin origin. This discrepancy, between the state observed in the Central American specimens and that described for *G. strumosus*, led us to examine variation in this and other characters in specimens from throughout the western Atlantic area ascribed to *G. strumosus*. Characters examined included position of the anus, presence and conformation of head barbels and nasal dermal flaps, coloration of head, and body proportions (for listing see Table 2). Specimens from the seven areas were not found to differ between areas with respect to meristics or characters other than those discussed below.

Position of the anus. — The position of the anus, expressed as the distance from the anus to the anal-fin origin in thousandths of the SL, was examined for specimens from the following locations: U.S. Atlantic Coast (Virginia to Florida); U.S. Gulf of Mexico (Florida to Texas); Mexico (Campeche); Belize; Guatemala; Honduras; Panama; Venezuela; Brazil. Regression lines and 95% confidence limits for those lines are presented in Fig. 6. The results for specimens from all areas except Venezuela and Brazil show allometric growth, larger specimens having the anus closer to the anal-fin origin than smaller specimens. Values for this character appear to vary clinally from north to south, with the anus closest to the anal-fin origin in the northern specimens and closer to the posterior margin of the disc in the specimens from

Table 2. Characters used in the principal components analysis of *Gobiesox* data with the loadings of each character on principle components I and II.

Character	PC I	PC II
(1) Head length	.38	-.54
(2) Head width	.38	-.56
(3) Snout length	.69	.00
(4) Eye diameter	.11	-.36
(5) Bony interorbital width	-.29	-.04
(6) Anus to anal-fin origin	-.83	.18
(7) Dorsal fin origin to caudal-fin base	.64	.49
(8) Dorsal fin origin to base of upper pectoral-fin ray	-.73	-.29
(9) Base of last dorsal-fin ray to caudal-fin base	-.56	.30
(10) Dorsal-fin length	.80	.12
(11) Disc length	-.38	-.56
(12) Caudal peduncle length	-.15	.65
(13) Caudal peduncle depth	-.09	-.37

Venezuela. The few individuals from southern Brazil exhibited considerable variation and did not follow the north/south trend.

Head barbels, nasal dermal flaps and head color. — Examination of material from the various areas revealed that specimens from the Gulf and Atlantic coasts of the United States and from Campeche, Mexico, differ from those to the south, Belize to Brazil, in several characters. The southern specimens possess well developed barbels on the pre- and suborbital areas, whereas these are either absent or represented by small bumps in the northern specimens (Fig. 7). The dermal flaps on the anterior nostrils of southern individuals are fringed (branched into several points), whereas in the northern specimens the margin of the bilobed dermal flap is smooth (Fig. 7). Because of the large amount of mucous that is produced when clingfishes are preserved, determination of color patterns is difficult; however, in those individuals where the amount of mucous was less or when scraped away, it was possible to determine the color pattern on the head. For these individuals it appears there are fewer, wider lines radiating from the eye in the northern specimens (Fig. 7).

Body proportions. — In all, 26 morphometric characters (Table 3) were examined. Thirteen of these were chosen for principal components analysis (PCA) — a method that can be used to descriptively portray aspects of the major structure of the data without requiring *a priori* assumptions about that structure (Neff and Smith, 1979). The thirteen characters selected for PCA, entered as thousandths of the SL, are listed in Table 2. Data from a total of 79 specimens formed the basis for the PCA. These specimens were distributed among seven major areas: Atlantic (n = 17) including Bermuda, Florida, Georgia, St. Martins, Virginia; U.S. Gulf Coast (n = 16) including Florida, Mississippi, Texas; Campeche, Mexico (n = 10); Belize (n = 10); Panama (n = 10); Venezuela (n = 10); Brazil (n = 6). Results of the PCA for the first two axes are given in Fig. 8. The separation between northern and southern specimens along the first principal component axis is clearly visible if not absolute. The north/south variation in distance from anus to anal-fin origin (Fig. 6, Table 2) explains part of the separation; however, despite the variation in this character among the 6 Brazilian specimens, the PCA results indicate their membership in the southern group. The Brazilian specimens have the nasal dermal flaps and barbels distinguishing the southern specimens (Fig. 7).

On the basis of the differences in the nasal dermal flaps and possession of barbels on the pre- and suborbital regions, providing 100% separation between northern and southern specimens, a separation suported by the morphometric analysis, we believe the northern and southern forms to be distinct species. All of the currently recognized synonyms of *G. strumosus* are from northern areas

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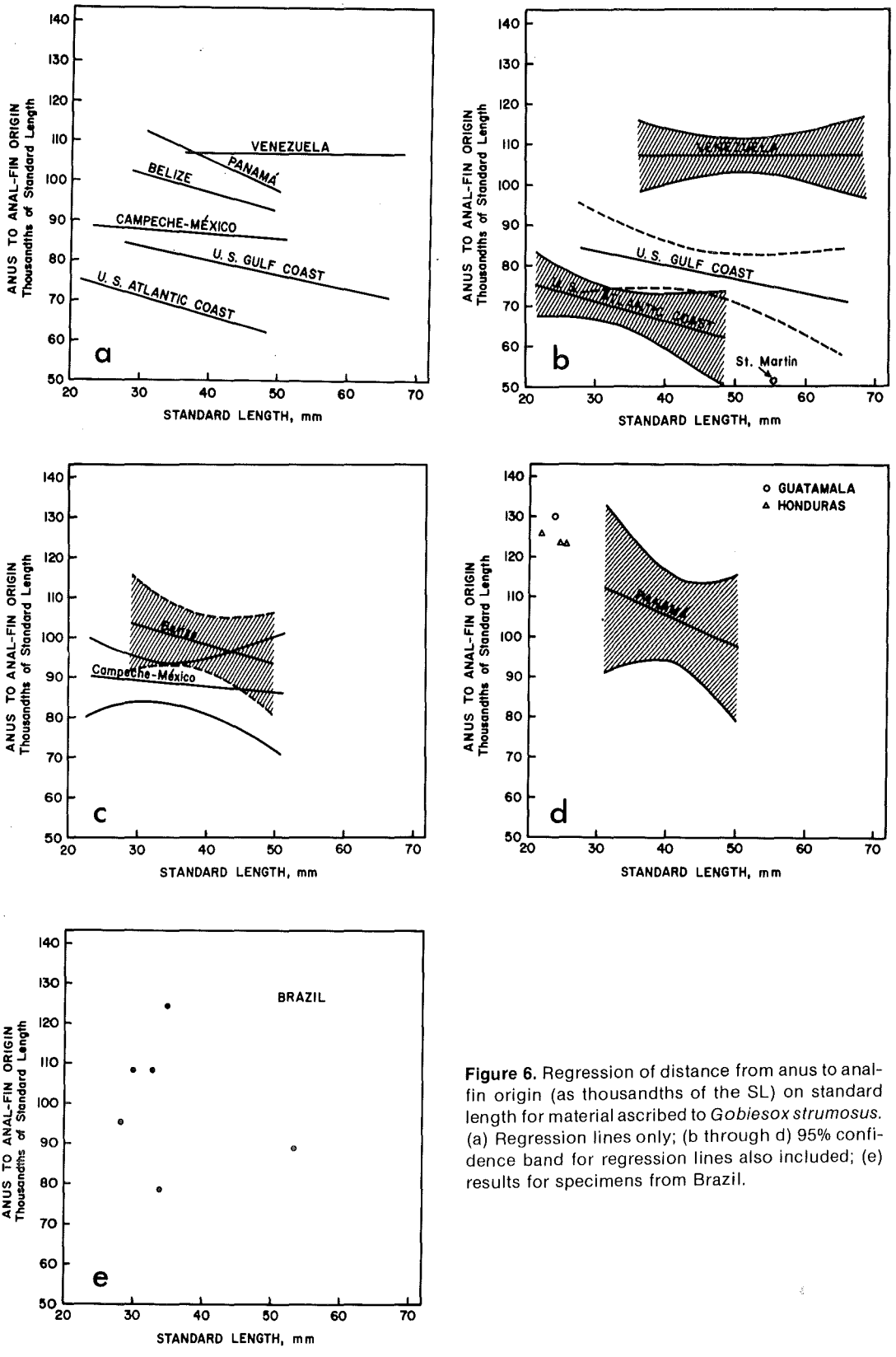

Figure 6. Regression of distance from anus to anal-fin origin (as thousandths of the SL) on standard length for material ascribed to *Gobiesox strumosus*. (a) Regression lines only; (b through d) 95% confidence band for regression lines also included; (e) results for specimens from Brazil.

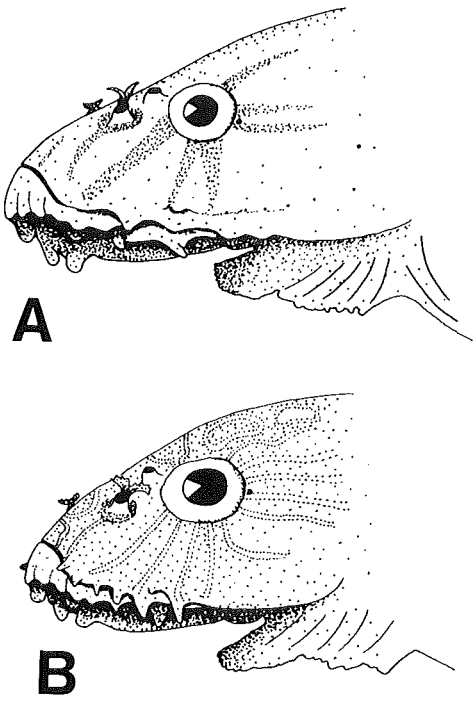

Figure 7. Lateral views of head of specimens ascribed to *Gobiesox strumosus:*
(A) 40.0, mm SL, UF 5430 (= *G. strumosus)*
(B) 36.4, mm SL, GCRL 15655 (= *G. barbatulus)*
(drawn by D.W. Greenfield)

Table 3. Ranges and mean values for morphometric data of *Gobiesox barbatulus* and *G. strumosus* expressed in thousands of standard length. Ranges appear in parentheses.

Character	*G.strumosus*	*G. barbatulus*
N	43	36
Head length	381.5 (331-409)	373.5 (338-408)
Head width	373.1 (334-425)	361.9 (315-398)
Snout length	95.6 (72-108)	80.2 (61-97)
Eye diameter	65.3 (47-84)	64.3 (48-75)
Bony interorbital width	90.4 (76-114)	93.2 (60-115)
Anus to disc	115.1 (81-146)	98 (67-125)
Anus to anal-fin origin	75 (51-100)	103.1 (79-127)
Dorsal-caudal distance	378 (343-405)	357.9 (328-390)
Dorsal origin to pectoral-fin base	293 (264-349)	323.8 (291-354)
Postdorsal-caudal distance	99.7 (82-130)	110.9 (80-133)
Dorsal fin length	271.7 (235-303)	248 (220-274)
Disc length	351.8 (295-388)	373.1 (331-410)
Caudal peduncle length	98.2 (81-131)	99.9 (84-117)

with the exception of *G. barbatulus,* described by Starks in 1913 from Natal, Brazil. Thus, *G. strumosus* has priority for the northern populations and applies to those from the Atlantic and Gulf coasts of the United States, the Gulf coast of Mexico, Bermuda and St. Martin in the northern Lesser Antilles.

Although the 6 specimens from Brazil differ from the remainder of the southern specimens in two body proportions (variability of position of anus and disc length) they agree in possessing a fringed nasal dermal flap and pre- and suborbital barbels. We have been unable to locate any specimens from between Venezuela and Natal, Brazil. For the present we consider the Brazil populations to be conspecific with the populations from northern South America and Central America. The name *Gobiesox barbatulus* is available for the southern group.

The apparent clinal variation in the position of the anus (Fig. 6), the partial ambiguity of the PCA results, and the lack of any other known differences between northern and southern forms might be used to argue that the two groups represent subspecies rather than full species. There is, however, no clinal variation in the configuration of the head barbels or nasal dermal flaps - the separation between northern and southern forms in our material is absolute. Similarly distinctive is the difference in coloration of the head, although this statement is based on examination of fewer individuals. Although the area between Campeche and Belize has been collected by several ichthyologists, no *strumosus*-like form has been taken. This may well be

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related to a hiatus in the distribution of rivers and river-discharge along the east and northeast of the Yucatan Peninsula, and consequently in the brackish water in which the two species occur. Zoogeographically, *Gobiesox strumosus* and *G. barbatulus* are clearly members of the ontinental fish fauna (Robins, 1971; Gilbert, 1973). In Belize we have taken *G. barbatulus* only along the mainland in spite of intensive collecting at the offshore cays between the mainland and the barrier reef, on the barrier reef and also on the atolls. Thus at least in Belize, *G. barbatulus* appears to be restricted to strictly continental situations — it has only been taken in areas of rich mangrove development and brackish water. The separation of *G. strumosus* into two species, *G. strumosus* to the north and *G. barbatulus* to the south, is concordant with Robins' (1971) and Gilbert's (1973) division of the continental fish fauna into northern and southern elements.

Gobiesox barbatulus Starks

Gobiesox barbatulus Starks, 1913: 73 (original description, Natal, Brazil). Fig. 9. Diagnosis. — A species of *Gobiesox* with lobe-like papillae on central margin of upper lip. Fleshy pad on pectoral-fin base with free posterior margin extending to point opposite gill membrane attachment. No small papillae at center of upper lip between margin and premaxillary groove. Dorsal-fin origin usually closer to upper pectoral-fin base than to caudal-fin base, but rarely may be midway between or slightly closer to caudal-fin base. Position of anus variable, usually midway between anal-fin origin and posterior margin of disc or closer to disc, but may be closer to anal-fin origin. Eye 0.9-2.2 in bony interorbital space and 4.9-7.6 in head length. Each part of disc region C bears 3-5 longitudinal rows of papillae; there are 7 to 10 rows across width of disc region A. Anterior nostril with large dermal flap branched into several points extending from its posterior margin. Pre- and suborbital region with well developed barbels. Dorsal-fin elements 10-12 (modally 11), anal-fin elements 8-9 (modally 9), pectoral-fin elements 22-27 (modally 25), caudal-fin rays 10-13, vertebrae 25-27 (modally 26). *G. barbatulus* is most closely related to *G. strumosus* from which it differs most markedly in the following characters: well-developed barbels on the pre- and suborbital areas present (vs. lacking or represented by small bumps); dermal flaps on anterior nostrils fringed (vs. smooth); pattern of pigmentation around eye (Fig. 7B vs. 7A). Description. — Body depressed, depth 4.5-6.1 in SL. Caudal peduncle short, varying from deeper than long to 1.2 in its length. Anus located anterior to dorsal-fin origin or under first element of dorsal fin. Head well depressed, length 2.4-2.9 and width 2.5-3.1 in SL. Snout shallow with slightly rounded outline, 3.3-5.6 in head length. Posterior nostril directly above anterior edge of eye. Teeth in lower jaw in 2 rows anteriorly, single row posteriorly, those of outer row much larger; front 3 to 5 pairs compressed incisors rounded at tips in larger specimens, very shallow trifid in smaller specimens. Teeth at front of upper jaw conical, irregular in size and position, forming deep patch, followed on each side by row of smaller canines. Five or six shallow rakers on each of the two posterior gill arches.

Papillae on head well developed barbel-like structures. Upper attachment of gill membrane opposite 6th-8th pectoral-fin ray. Subopercular spine well developed but hidden under skin of opercle region.

Dorsal-caudal distance forward extends to a point well in front of upper pectoral-fin base; post dorsal-caudal

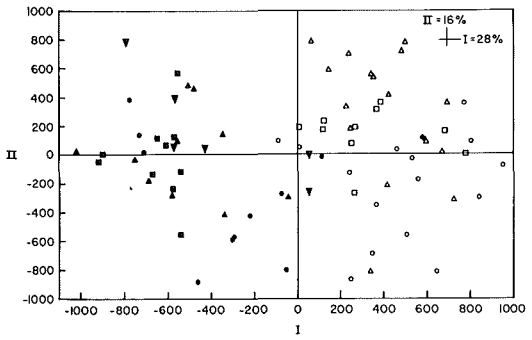

Figure 8. Relative position of specimen of *Gobiesox* from northern (open symbols) and southern (closed symbols) areas in the projection of the first two principal components of a 13 character correlation matrix. Component scores (ordinate, abscissa) are multiplied by 1,000.
Key: northern areas —
Atlantic (○), Gulf Coast (△),
Campeche (□);
southern areas —
Belize (●), Panama (▲),
Venezuela (■), Brazil (▼).
See text for content of each area.

distance 1.8-3.1 in length of dorsal-fin base. Length of disc 2.4-3.0 in SL. Depressed tip of anal fin extends to or beyond a vertical line from caudal-fin base.

Body proportions in thousandths of SL are presented in Table 3. Measurements based on 36 individuals, 28.4-62.7 mm SL.

Material examined: 65 specimens from 13 collections. BRAZIL: CAS-SU 22521 (3 cotypes, 19.2-21.2 mm SL): CAS—SU 17415 (1, 28.5), Espirito Santo; GCRL 9632 (4, 30.2-35.2), Bahia; UF 19230 (1, 53.7), Bahia. VENEZUELA: GCRL 15655 (26, 36.4-62.7) Nueva Espanta. PANAMA: GCRL 10233 (6,30.8-50.3), Colon; GCRL 12911 (6,31.7-49.2), Colon. HONDURAS: GCRL 4446 (1, 24.8), Cortes; GCRL 4459 (2,22.1-25.3), Cortes; FMNH 83897 (3, 13.0-14.7), Brus Lagoon, Gracias a Dios; GUATEMALA: GCRL 4617 (1, 24.2), Izabel. BELIZE: FMNH 83895 (5, 28.4-49-5) Placentia, Stann Creek District; FMNH 83896 (3, 30.1-41.2) and UMMZ 209482 (3, 37.7-39.2), both from, Moho Cay, Landivar area, Belize City, Belize District.

Gobiesox strumosus Cope

Gobiesox strumosus Cope, 1870: 121 (original description, Hilton Head, South Carolina).

Diagnosis. — A species of *Gobiesox* with lobe-like papillae on central margin of upper lip. Fleshy pad on pectoral-fin base with free posterior margin extending to point opposite gill membrane attachment. No small papillae at center of upper lip between margin and premaxillary groove. Dorsal-fin origin much closer to upper pectoral-fin base than to caudal-fin base. Anus usually closer to anal-fin origin than to posterior margin of disc, but sometimes midway.

Eye 0.9-2.3 in bony interorbital space and 4.5-8.1 in head length. Each part of disc region C bears 3-5 longitudinal rows of papillae; there are 7 to 10 rows across width of disc region A. Anterior nostril with large, bilobed dermal flap extending from its posterior margin with smooth edges. Pre- and suborbital regions lacking well-developed barbels. Dorsal-fin elements 10-12 (modally 11), anal-fin elements 8-9 (modally 9), pectoral-fin elements 22-27 (modally 25), caudal-fin rays 10-12, vertebrae 24-28 (modally 26). *G. strumosus* is most closely related to *G. barbatulus* from which it differs most markedly in the following characters: barbels on pre-and suborbital areas lacking or at most represented by small bumps (vs. well-developed); dermal flaps on anterior nostril with smooth margins (vs. fringed); pattern of pigmentation around eye (Fig. 7A vs. 7B).

Description. — Body depressed, depth 5.0-6.7 in SL. Caudal peduncle short, varying from deeper than long to 1.2 in its length. Anus located from just anterior to dorsal-fin origin to under third element of dorsal fin. Head well depressed, length 2.4-3.0 and width 2.4-3.0 in SL. Snout shallow with slightly rounded outline, 3.8-

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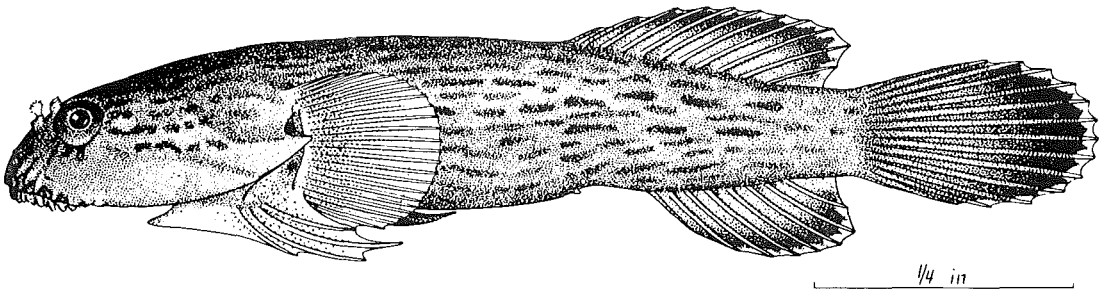

Figure 9. *Gobiesox barbatulus*, cotype, ca. 21.2 mm SL, Natal, Brazil (from Starks, 1913, plate XIV).

6.1 in head length. Posterior nostril directly above anterior edge of eye. Teeth in lower jaw in 2 rows anteriorly, single row posteriorly, those of outer row much larger; front 3 to 5 pairs compressed incisors rounded at tips in larger specimens, very shallow trifid in smaller. Teeth at front of upper jaw conical, irregular in size and position, forming deep patch, followed on each side by row of smaller canines. Six or 7 shallow rakers on each of the two posterior gill arches.

All papillae on head shallow, lobe-like structures. Upper attachment of gill membrane opposite 6th — 8th pectoral-fin ray. Subopercular spine well developed but hidden under skin of opercle region.

Dorsal-caudal distance forward extends to a point well in front of upper pectoral-fin base; postdorsal-caudal distance 1.9-3.5 in length of dorsal-fin base. Length of disc 2.6-3.4 in SL. Depressed tip of anal fin extends to or beyond a vertical line from caudal-fin base.

Body proportions in thousandths of SL are presented in Table 3. Measurements based on 43 individuals, 21.3-66.3 mm SL.

Material examined. — 214 specimens from 14 collections. U.S. ATLANTIC COAST. Virginia: UF 883 (2, 25.6-27.2 mm SL), Gloucester Co.; FMNH 42924 (3, 28.1-36.4), Chesapeake Bay. Georgia: UF 5430 (3, 30.3-40.0). Glynn Co.; UF 28709 (7,24.0-48.5), Glynn Co. Florida: UF 12042 (5, 12.4-25.7), Indian River Co.; UF 28711 (1, 34.0), Brevard Co. Florida Keys, Plantation Key, FMNH 91582 (2). GULF OF MEXICO. Florida: UF 4124 (1, 39.2), Pinellas Co.; UF 19775 (1, 34.8), Citrus Co. Mississippi: GCRL 899 (86, 27.6-66.2), Ship Island. Texas: FMNH 40292 (2, 48.8-50.0), Corpus Cristi. MEXICO. GCRL 5091 (98, 14.8-51.7), Campeche. BERMUDA. FMNH 48586 (2, 33.2-46.0). St. Martin. ZMA 104.846 (holotype, *G. sanctimartini,* 55.8).

Gobiesox nudus (Linnaeus, 1754)

This species is limited to freshwater streams of the Atlantic drainage and is known from Dominica, Cuba, Venezuela and Panama (Briggs, 1955). This appears to be the first record for Honduras. Our single (10.1 mm SL) specimen was taken in an intermittant stream (series of isolated pools and stream sections during dry season) near Port Royal on the south side of Roatan. Also taken were *Anguilla, Agonostomus, Dormitator, Eleotris, Gobiomorus* and *Poecilia.* Material examined. — one specimen from one collection. HONDURAS, IR, FMNH 84958.

Gobiesox punctulatus (Poey 1875)

This species has been recorded from Texas south along the coast of Central America to Panama and east along the northern coast of South America to Venezuela (Briggs, 1955; Cervigon, 1966; Birdsong and Emery, 1968). It has also been recorded from the Bahamas, Florida and the Lesser and Greater Antilles (Briggs, 1955). It has been taken at Grand Cayman and at Isla de Providencia (Burgess and Gilbert, pers. comm.).

Measurements for ten specimens from Belize (24.9-57.3 mm SL) are presented in Table 4. Counts for 29 specimens from Belize and 12 specimens from Puerto Rico are presented in Table 5. The specimens from Belize have fewer dorsal-fin rays than those from Puerto Rico.

All of our records for *G. punctulatus* from Belize and Honduras are from stations in less than 15 feet, usually 5 feet or less, from areas with coral rubble. In Belize all of our specimens were taken either at Glover's Reef, on the Barrier Reef (Carrie Bow Cay) or at the Snake Cays in southern Belize where insular conditions prevail.

Table 4. Ranges and mean values for morphometric data of *Gobiesox punctulatus* from Belize (FMNH 83899) expressed in thousandths of standard length.

Character	Mean	Range
N = 10 (24.9-55.9 mm SL)		
Head length	372.9	352-400
Head width	396.4	359-427
Snout length	88.5	77-103
Eye diameter	61.9	52-70
Bony interorbital width	84.0	72-99
Anus to disc	74.2	61-94
Anus to anal-fin origin	129.5	109-152
Dorsal-caudal distance	380.0	364-402
Dorsal origin to pectoral-fin base	304.1	280-334
Postdorsal-caudal distance	103.5	89-113
Dorsal-fin length	275.4	254-306
Disc length	390.9	371-408
Caudal peduncle length	98.0	91-105
Caudal peduncle depth	91.8	82-101

Material examined. — A total of 194 specimens from 10 collections. HONDURAS: IR, FMNH 83901 (25), CC, FMNH 83904 (7), FMNH 83905 (32), FMNH 83906 (1), FMNH 83907 (1); UMMZ 209483 (25). BELIZE: CBC, FMNH 83902 (4); GR, FMNH 83899 (82), FMNH 83908 (3); MSC, FMNH 83900 (1); SSC, 89309 (13). Additional material — BELIZE, CBC JWC - 13 (1); Puerto Rico, FMNH 61697 (28); Serrana Bank, FMNH 90577 (6).

Table 5. Frequency distributions for meristic data for *Gobiesox punctulatus* from Belize (FMNH 83899) and Puerto Rico (FMNH 61697).

	Dorsal-fin Elements				Anal-fin Elements			Pectoral-fin Elements		
	9	10	11	12	6	7	8	19	20	21
BELIZE	1	25	3		1	27	1	4	15	10
PUERTO RICO	1		6	5		10	2	2	6	4

Tomicodon fasciatus fasciatus (Peters, 1860)

According to Briggs (1955, p. 66) *Tomicodon fasciatus* is divisible into two subspecies, *Tomicodon fasciatus australis* (Briggs, 1955), known only from Brazil, and the nominate subspecies represented in our collection from Belize and Honduras. *Tomicodon fasciatus fasciatus* is known from the Bahamas, Greater and Lesser Antilles, Curacao, Panama, Guatemala and Belize (Briggs 1955, 1969b, Böhlke and Chaplin 1968, Birdsong and Emery 1968, Randall 1968). It has been taken at Grand Cayman and at Isla de Providencia (Burgess and Gilbert, pers. comm.). Both Randall (1968, p. 289) and Böhlke and Chaplin (1968, p. 704) indicate the apparent association of *T. f. fasciatus* with rocky substrates in shallow water. In our material the majority of specimens (23 of 28) and collections (6 of 10) of this species came from very shallow-water areas of rocky ledges or intertidal pools at the Hog Islands, Roatan and Glovers Reef. One

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specimen came from a mangrove cay inside the barrier reef and one specimen from pier pilings at Long Cay, Glovers Reef. Two collections were from areas of rich shallow-water reef development. Most collections and specimens were from stations in less than 4 feet of water. In Honduras *T. f. fasciatus* was taken at the Hog Islands and Roatan. In Belize this species was taken at a mangrove cay (UNC) inside the barrier reef, at the barrier reef (CBC) and Glovers Reef.

Material examined. - A total of 28 specimens from 10 collections. HONDURAS: CC, FMNH 93750 (6), FMNH 93751 (1), 93752 (2); IR, FMNH 93749 (5), FMNH 94186 (1). BELIZE: AC, FMNH 94187 (1); CBC, FMNH 93758 (1); GR, FMNH 93753 (1), FMNH 93755 (1), FMNH 93756 (9), FMNH 93757 (2); UNC, FMNH 93754 (1). Additional material examined — collected D.M. and A. Cohen or by IMSWE personnel. 29 specimens from 5 collections. BELIZE, CBC: FMNH 93759 (3), FMNH 93760 (14), FMNH 93761 (6), FMNH 93762 (1), FMNH 93763 (5).

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